DOE Pollution Prevention Award Nomination

Nominee: ESA-WMM Machine Shop, Los Alamos National Laboratory

Category: Model Facility

Abstract:

In the early 1990's, Los Alamos National Laboratory's ESA Machine Shop produced numerous wastestreams ranging from scrap paper to radioactive scrap metal and hazardous industrial chemicals. Since 1993, managers and workers have initiated facility-wide waste prevention procedures that reduce or eliminate wastestreams, while developing a new environmental ethic exemplified by operational practices that go far beyond regulatory compliance. Due to management and employee commitment, the shop now minimizes waste and associated costs through conscientious planning, purchasing, and recycling, while developing environmentally-oriented operational procedures; investing in new technologies- sharing these with other facilities; and serving as a leader in waste prevention.

Nomination:

The Engineering Sciences and Applications Division Machine Shop (ESA Machine Shop) at Los Alamos National Laboratory (LANL) processes non-hazardous, radioactive, and hazardous materials. From its start in the 1950's through the early 1990's, the Machine Shop produced numerous environmental wastestreams that included product waste- scrap metal (from the machining of non-radioactive components in a radioactively controlled environment), process waste- industrial chemicals, discarded parts, tools, packing materials, and administrative waste- office equipment and supplies.

Waste materials leaving the facility were indiscriminately combined and disposed as "low-level" or "mixed" radioactive waste. The wastestream was designated as *contaminated waste* even though only a small fraction of the wastestream was potentially contaminated with radioactivity.

In addition to the radioactive waste created by the shop, large amounts of *biocide* coolant were used for machining parts. Though not radioactively contaminated, the coolant was hazardous to the environment and potentially hazardous to workers. The coolant had a maximum useful life of 2 months, but it quickly developed a bacterial coating that rendered it unusable, requiring frequent disposal- as often as once a week.

To reduce waste, and to move beyond mere compliance with environmental regulations, ESA Division leaders called for reductions in the wastestreams created by the Machine Shop. In 1995, shop managers began their pollution prevention efforts with the machining coolant, replacing the potentially harmful chemicals with water-based coolants containing 98% water, 2% rust inhibitors, and no biocides. They also invested in passive *skimmers* that re-circulate and filter the coolant, extending its useful life by eliminating bacterial growth in the coolant sump. The useful life of the coolant was extended over a year and waste was reduced 97%- from 14,400 kilograms per year to 400 kg/year- and annual disposal costs dropped from $102,000 to $3,000. (FIGURE 1) Following the success of the coolant replacement, shop supervisors shared this innovation with other DOE facilities, including facilities within LANL, and these same changes have now been successfully implemented at the other DOE sites including the Sandia Albuquerque Machine Shop.

Shop managers realized they could go beyond this initial success by investing in an *evaporator* that removes water from the used, discarded coolant. The *evaporator* has

transformed the machining coolant wastestream into a zero discharge closed-loop, annually yielding 2000 gallons of reusable oil that can be transferred to a recycling facility; the chemical wastestream has been converted into a resource and the end result is zero coolant waste.

Overall reduction in hazardous waste, including the machine coolant, has dropped progressively since FY 1995. In that year the shop produced 26,302 kilograms of hazardous waste and by FY 2000 that number had fallen to 851 kilograms- a waste decrease of 96% with cost savings of $279,961. (FIGURE 2)

To cope with the large volume of product and process waste from the potentially radioactive wastestream, shop personnel initiated a major, yet low-cost change by segregating all machining equipment and tooling, designating these for use with either radioactive or non-radioactive materials. (Photos 1,2) Workers followed with other waste prevention ideas by segregating material waste so items would not automatically be designated as contaminated waste.

To address the specific problem of contaminated machining materials, all potentially radioactive scrap was segregated for further monitoring (see “chipper/ conveyor” below). All other scrap materials including cardboard, paper, used equipment, and other supplies were segregated and monitored (surveyed) immediately to keep them out of the contaminated wastestream.

Another method for reducing the potential radioactive wastestream is a low-cost color-code system that is used throughout the facility for tools, equipment, bins containing recyclable scrap material and rags, and any remaining waste- yellow for radioactive contamination; green for “clean,” (PHOTO 3) The extent of staff involvement is evidenced by the shop custodians who initiated color-coding for brooms, dustpans, and mops- further avoiding the mixing of

waste. Now, due to the custodians initiative, even floor sweepings are segregated and surveyed for radioactivity, and, when possible, kept out of the radioactive waste.

In addition to materials segregation, the Machine Shop recently invested in the development of a new sustainable design technology that will reduce the contaminated wastestream even further. The shop annually generates over 11.5 cubic meters (1500 pounds) of machined metal scrap "shavings," all of which is assumed potentially contaminated, even though only a minute fraction actually yields a small amount of radioactivity.

Initial attempts to manually separate and monitor the contaminated scrap metals from non-hazardous shavings were unsatisfactory, as the shavings tend to "ball up," leaving contaminated pieces (as small as a speck of ground pepper) virtually impossible to identify. Efforts to develop an effective technique to manually segregate and monitor contaminated scrap metal were undertaken, but after a year the success rate was only 40%. The shop needed to increase monitoring effectiveness, and they also hoped to automate the system.

Shop supervisors found a commercially available metal "chipper" and a conveyor system. The chipper required minor modifications, but for the monitoring system to meet Machine Shop requirements a new design was necessary. So, shop managers brought together a multi-disciplinary team - Radiological Control Technicians, Electricians, Health Physics experts, and representatives from the chipper manufacturer. They developed a practical design for a radiological monitoring system that would automatically detect radioactivity.

Based on the team's design, a prototype for automatically surveying contaminated metal chips was built and has been recently implemented. Chips are monitored automatically and when contaminated metal is detected the conveyor stops and a hand-held monitor is used to segregate the contaminated chip- allowing tiny amounts of radioactive particles to be isolated and

disposed. With the Chipper, the radioactive wastestream can be reduced by 95%, and the large residual volume of "clean" metal- over 1400 pounds annually- can be confidently recycled. In addition, recognizing its potential, the Ludlum Company, who built the survey prototype has decided to add the monitor to their product line, making this new radiological monitoring tool available to the entire nuclear industry.

Through these efforts environmental benefits are realized as valuable space is saved at the low-level waste dump. Moreover, with the chipper, annual disposal cost savings of $27,000 are projected for fy 2001, in addition to waste disposal cost savings of $130,000 from material segregation.

To complement these efforts- to "close the loop" on pollution- all products used in the Shop are selected on the basis of "environmental preferability." Before anything is purchased, questions are posed: Does the item meet the criteria of affirmative procurement- is the item made from recycled materials? What will happen to the product after its useful life in the shop- can it be reused or recycled? If a product cannot be reused or recycled, what are the disposal requirements and costs, and can potential wastestreams be avoided? On the basis of this purchasing criteria, numerous recycled content products are purchased including paper, toner cartridges, light bulbs, paint, and cleaning solutions.

Examples of the machine shop environmental ethic toward purchasing include the machine coolant (mentioned above) but smaller examples exist as well. For instance, tool bits for machining parts are now purchased with an *indexible cutting tool holder* that minimize the volume of contaminated *transuranic* waste. The bit can be reused or recycled rather than discarded as contaminated waste, and the new cutting edge disposal rate is one-tenth of that of a tool without it**.**

To further reduce waste, the staff has developed an administrative control for all waste leaving the facility. All equipment, supplies, tools, materials, and office equipment is entered into a computerized-inventory database and affixed with a unique barcode when the (waste) item leaves the shop. Personnel record and monitor each item, developing a waste history, or *legacy record*, and keep track of all waste leaving the facility. The system tracks different wastestreams and personnel know exactly what has gone into salvage, recycling, or the landfill.

The facility-wide effort and ongoing commitment to Pollution Prevention has led to multiple benefits including the reduction or elimination of chemical waste, radioactive waste, and waste from facility materials and tools. Segregation of materials and waste reduction combined with environmentally preferable purchasing- that anticipates potential waste generation and disposal costs- minimize the amount of material requiring disposal in the landfill, or as radioactive waste. More material is now reused or recycled; disposal costs have dropped and some waste (machine coolant oil) is even converted to a reusable product.

To further understand the benefits of the Machine Shop pollution prevention commitment it is necessary to recognize their impact as a leader in innovation, design and implementation, and their influence on other facilities. Shop personnel share operational procedures for waste-elimination with other facilities- helping others to reduce or eliminate their wastestreams. They have developed innovative, sustainable design technology that is now available industry-wide. They have shown that waste prevention need not be expensive to implement and investment in waste reduction technology can be cost-effective, even in a facility that handles hazardous and radioactive materials. And they have shown that every member of a staff can adopt a proactive environmental ethic and make effective contributions to operational practices that further waste minimization efforts and close the loop on pollution.

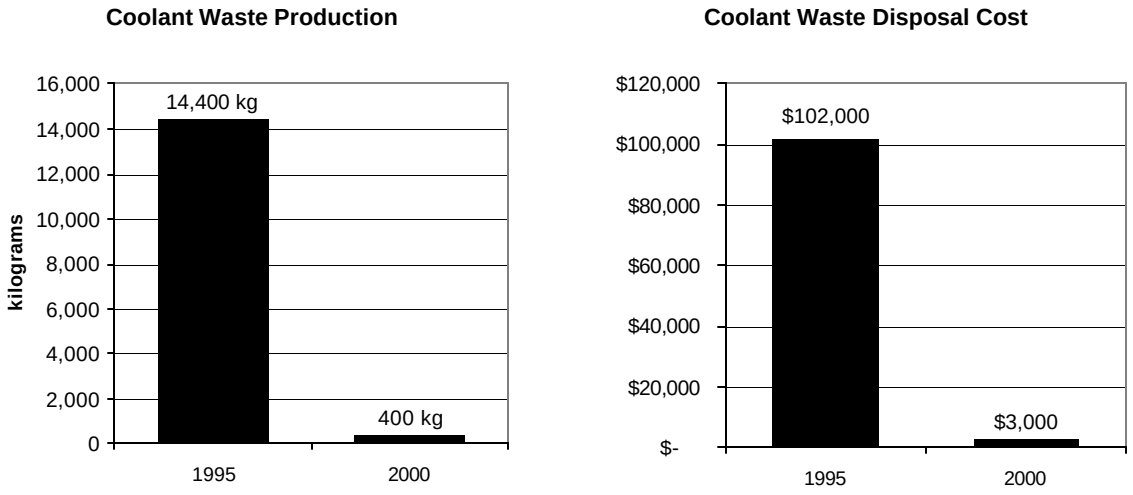

Figure 1: Coolant Production and Disposal Cost Comparison for 1995 and 2000

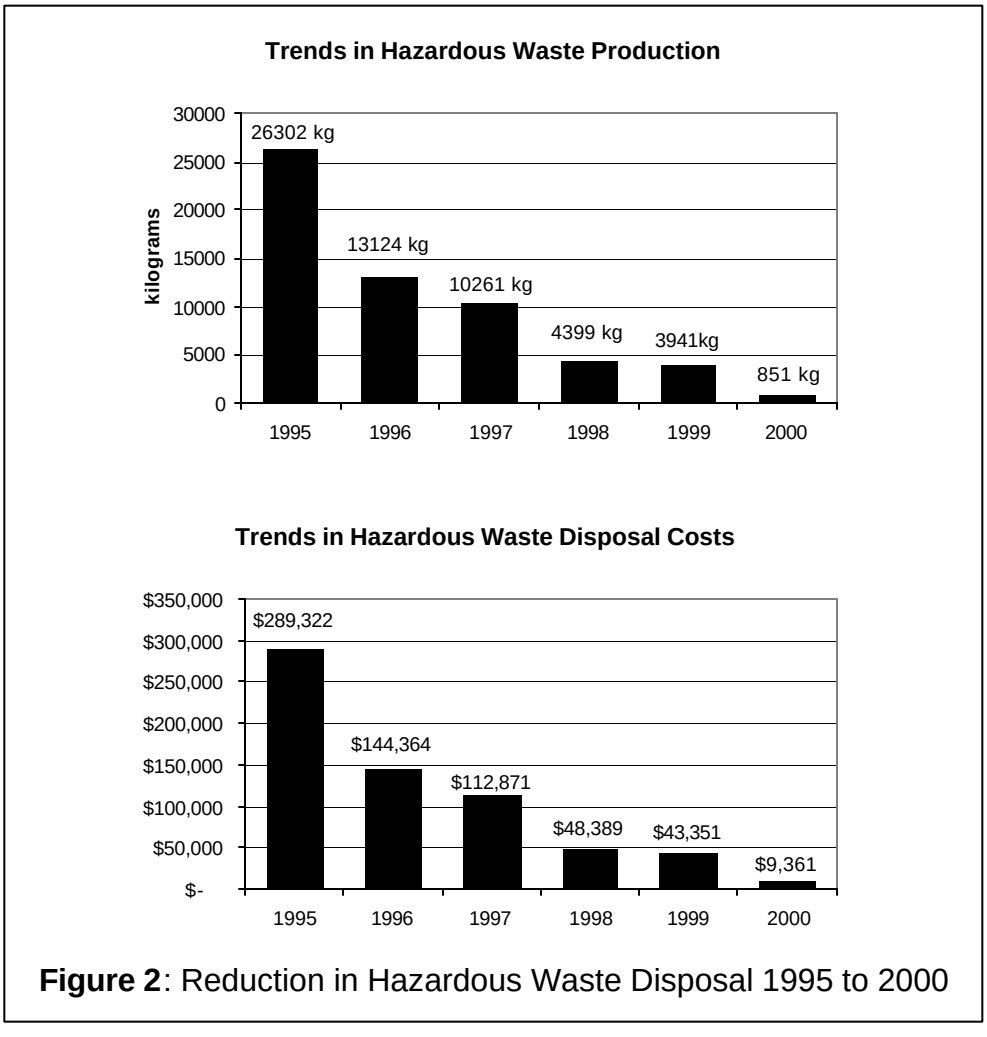

Figure 2: Reduction in Hazardous Waste Disposal 1995 to 2000

Photo 1: Technician operating precision cutting machine at the ESA Machine Shop (note blue material segregation sign)

Photo 2: Signs mounted on machines aid in segregation of waste material

Photo 3: Clearly labeled trash cans ensure proper segregation of waste